What Is Superheated Steam and What Are Its Uses?

Superheated steam is not just a 'cool' term, it is actually a very useful thing!

By Christopher McFadden
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Superheated steam sounds cool (well hot), but what is it? What can it actually be used for?

Here we explore what it is meant by the term superheated steam and uncover some of its interesting uses and benefits.

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What is superheated steam?

Superheated steam is a form of steam at a temperature higher than its source liquid's boiling point, aka vaporization point, under a given pressure.

It is a relative state to something called saturated, or wet, steam. This kind of steam is one that just exceeds the boiling point of the source at a given pressure.

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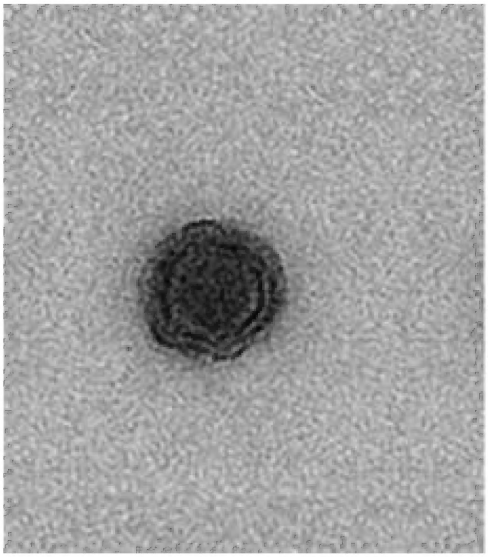
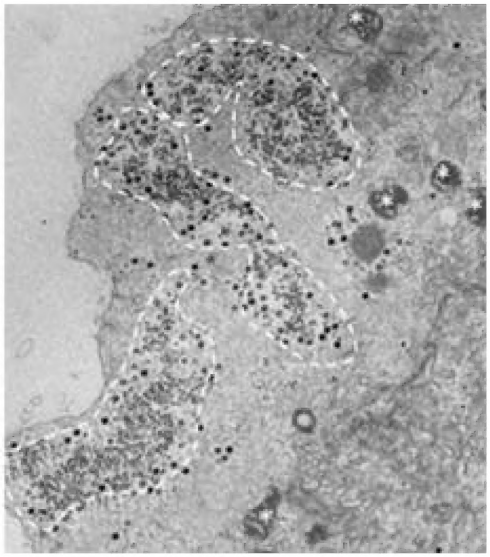
Saturated steam forms when both the source liquid and the vapor have the same temperature and evaporation/condensation rates are in equilibrium. In other words, steam and liquid can coexist in the same space.





If any additional heat and degrees of temperature are applied to the steam above this point it is
this point, most, if not all, traces of moisture tend to become erased forming "dry" and then su

Superheated steam "can therefore cool (lose internal energy) by some amount, resulting in a lo
condensing) from a gas, to a mixture of saturated vapor and liquid." - Wikipedia.

In fact, superheated water-derived steam has so much energy stored within it that it can actuall

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"If unsaturated steam (a mixture which contains both water vapor and liquid water droplets) is heated at constant pressure, its temperature will also remain constant as the vapor quality (think dryness or percent saturated vapor) increases towards 100%, and becomes dry (i.e., no saturated liquid) saturated steam. Continued heat input will then "super" heat the dry saturated steam." - Wikipedia.

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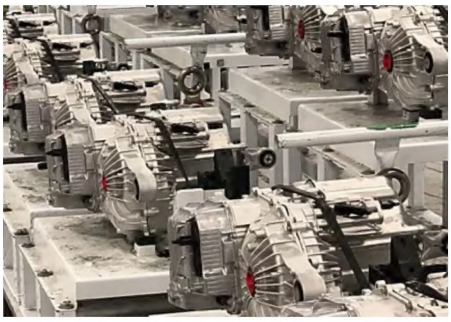

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Superheated steam can be generated by taking, for example, steam drawn from a boiler. It is then passed through a separate heating device, called a superheater, to transfer additional energy into the steam through direct contact or radiation.

This type of steam has a lot more energy than saturated, or wet, steam and can work harder than saturated steam. Superheated steam's energy content is, however, much less useful for certain applications.

"This is because superheated steam has the same heat transfer coefficient of air, making it an insulator and poor conductor of heat.

Saturated steam is preferred for heating applications, while superheated steam is used mostly in power generation and turbines. If steam is needed for both power generation and heating, the steam can be superheated then desuperheated to its saturated condition." - nationwideboiler.com.

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What is superheated steam used for?

Here are some typical uses for superheated steam.

1. Disinfection/Sterilization

While superheated steam does have some disinfection applications, it is not necessarily the best option. Superheated steam, is after all, effectively dry.

This is because superheated steam has some disadvantages to saturated, or wet, steam. The latter is actually better at transferring its heat than superheated steam making it more suitable for disinfection purposes.

Superheated steam must reach much higher temperatures than wet steam, resulting in the need for products to be exposed for a longer period of time. For the same reason, superheated steam is not useful for heating.

However, slightly superheated steam can be used for antimicrobial disinfection on things like biofilms and hard surfaces.

2. Power generation

Superheated steam is fantastic for things like electricity generation. Its tremendous internal energy can be put to good use for kinetic reactions through mechanical expansion against turbine blades and reciprocating pistons.

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Superheated steam is preferred over saturated steam because it can release a lot of its internal energy for work and remain above the liquid's water vapor point (at a given pressure within the turbine/piston engine).

At higher pressures, wet steam contains liquid droplets that are generally pretty hard to compress. Such droplets can also cause impact damage to mechanical elements of turbines and engines.

Saturated steam can also condense as it drops in temperature and pressure. Droplets of liquid that are formed can result in pitting of turbine blades.

With enough force, they can even bend, crack or fracture vital components of the turbine/engine. Obviously, this is not desirable, especially for larger, more expensive turbines.

Superheated steam also permits higher steam velocities through pipes (typically **100 m/s**). This means smaller pipes can be used to transmit it (so long as the pressure drop is not excessive).

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It also widely used in nuclear power plants.

3. Steam engines

Superheated steam was widely used in steam locomotives and other steam engines. It proved to be more economical and efficient than saturated steam for driving the locomotive.

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Because it is effectively dry, the steam was less likely to condense inside the locomotive's cylinders reducing the need for them to be periodically drained.

4. Processing

Superheated steam is also used for various processing applications like: -

- Drying
- Cleaning
- Steam oxidation
- Layering
- Reaction engineering
- Epoxy drying
- Curing

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- Chemical reaction processing
- Catalysis
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To name but a few.

It can also be used in food processing to great effect. As superheated steam can quickly transfer heat in the right circumstances, it can be used to rapidly heat something.

"The major advantages of using superheated steam for food processing are better product quality (color, shrinkage, and rehydration characteristics), reduced oxidation losses, and higher energy efficiency. " - Alfy A. *et al*.

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5. Pest control

Superheated steam can also be used for some forms of pest control. It can, for example, be used for soil steaming.

Here the steam is induced into the soil which causes almost all organic material to deteriorate. Soil steaming is an effective alternative to the use of chemicals in agriculture.

What is the temperature of superheated steam?

This will entirely depend on the source liquid in question. For the steam to become superheated it must exceed the boiling point of that liquid to such a degree that it loses most, if not all, liquid components.

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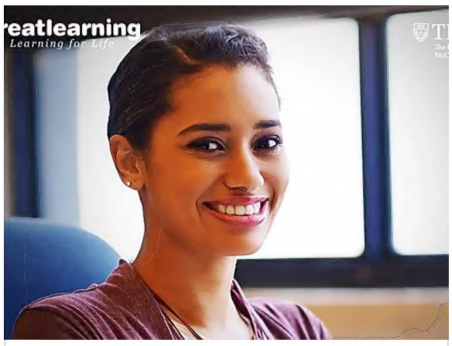

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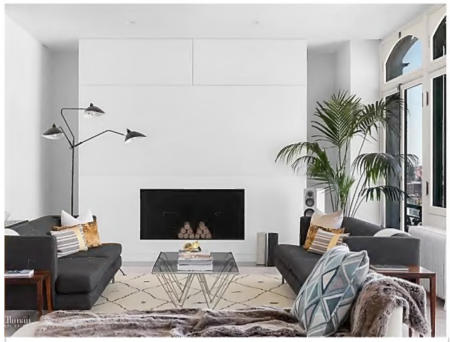

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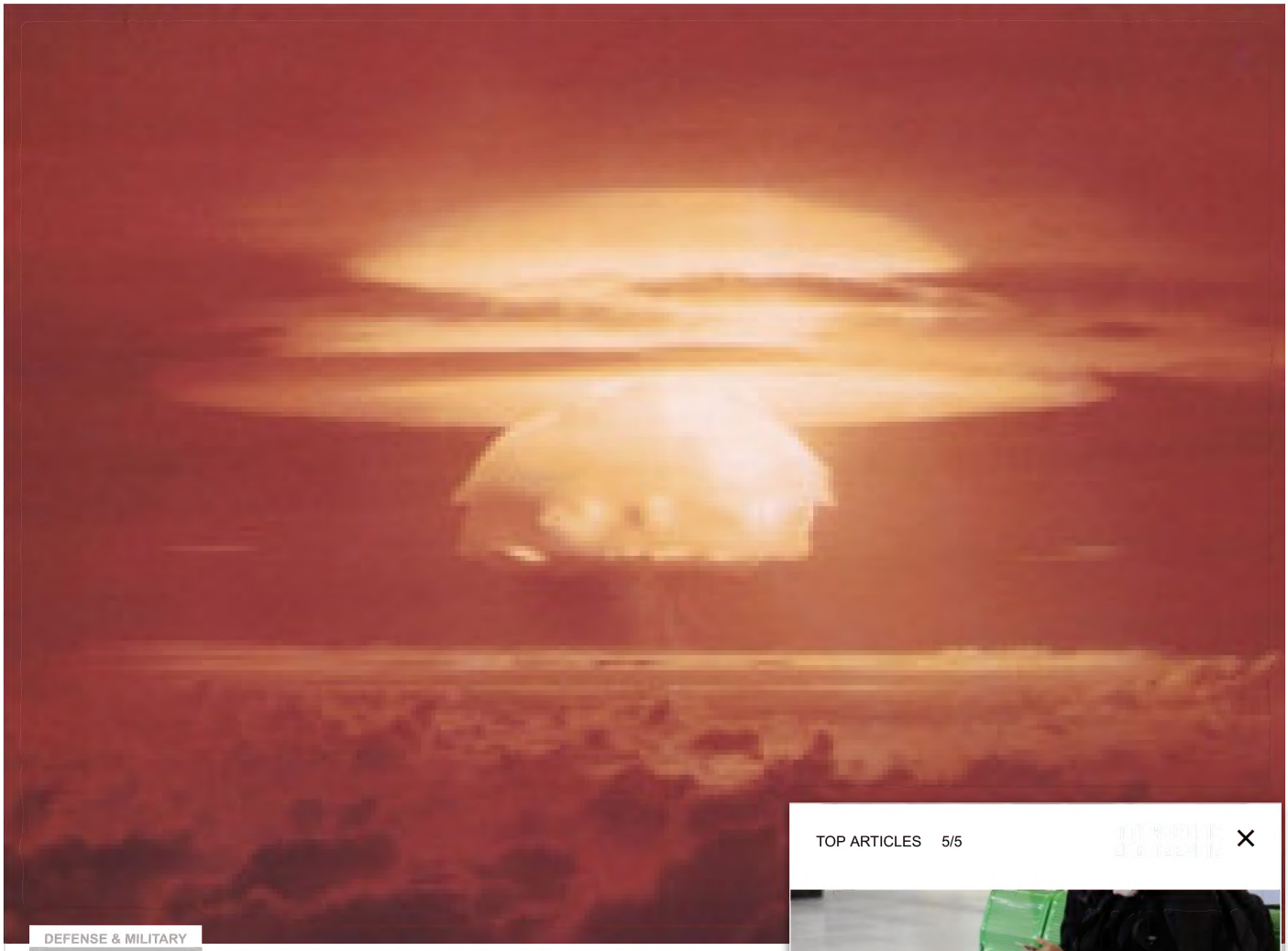

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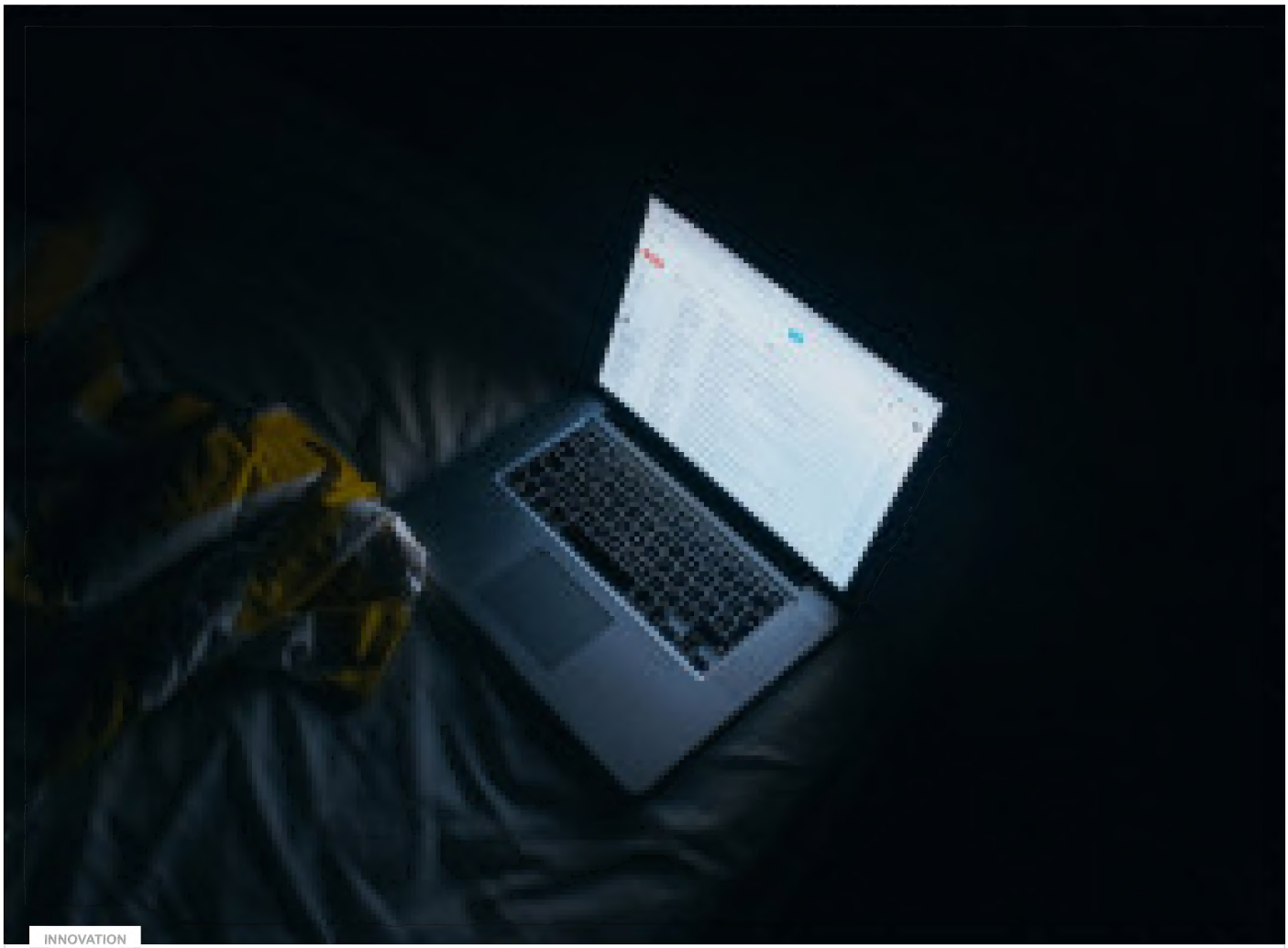

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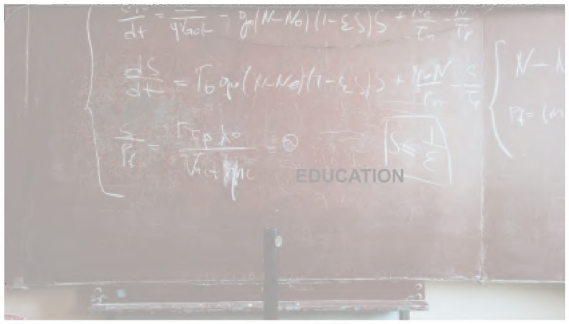

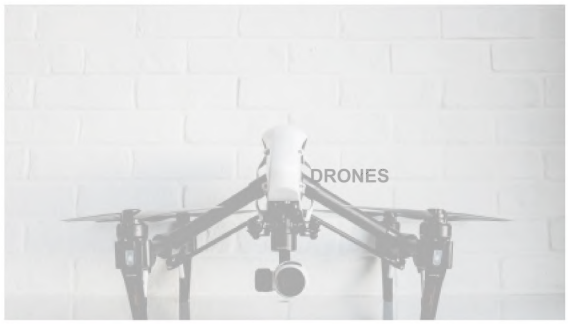

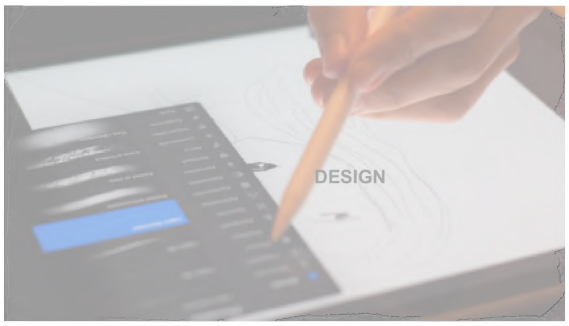

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